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Ames Research Center

LADEE E/PO

Brian Day – LADEE E/PO Lead
brian.h.day@nasa.gov

LADEE E/PO

Description:

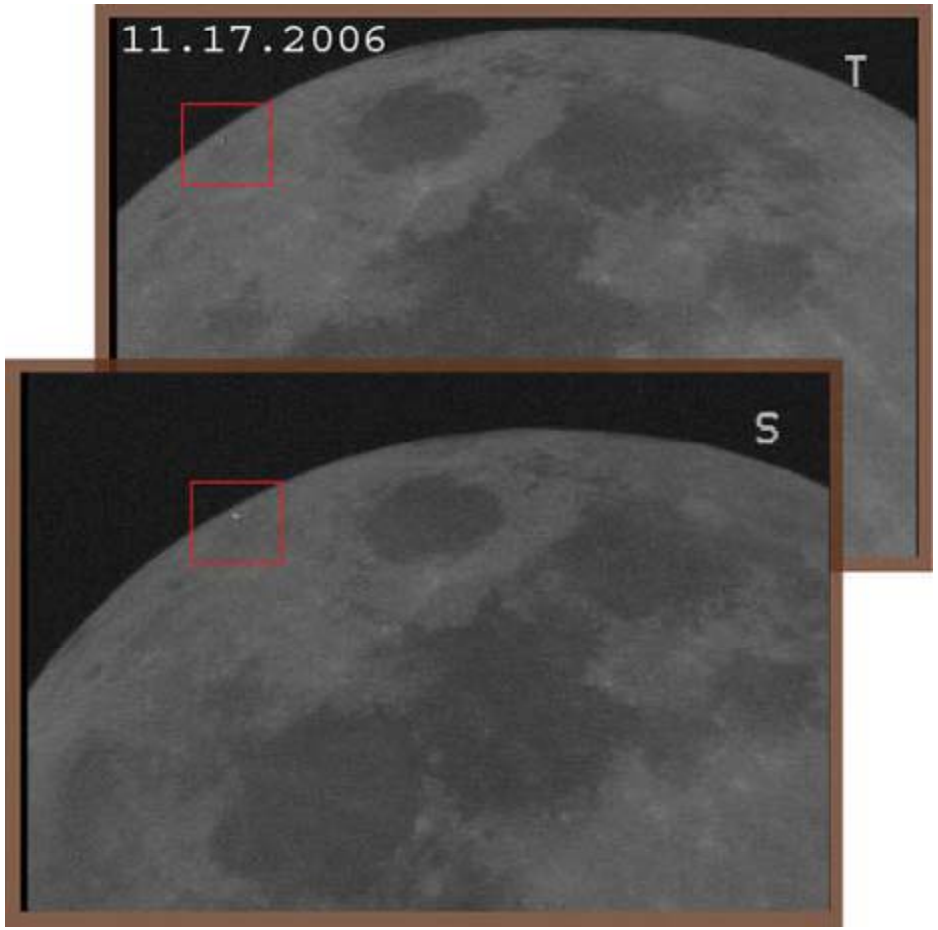
- Mission launch scheduled for May 2013.
- E/PO Implementation Plan approved by SMD May 31 2011.
- Educator Professional Development components will engage hundreds of educators.
  - In person workshops.
  - Online programs (NSTA, Cornell).
- Student programs will involve >10,000 students.
  - Partnerships facilitate dissemination.
  - Strong emphasis on Participatory Exploration.
- Public Outreach will reach tens of thousands and provide opportunities to directly participate in citizen science supporting the mission.
  - Partnerships facilitate dissemination.
  - Strong emphasis on Citizen Science.

LADEE Student Activity for the AEE and Challenger Centers

- Interactive multimedia activity simulating mission science operations center.
- Students assume the role of a researcher receiving data from LADEE during its mission.
- Provides an introduction to spectroscopy, the lunar atmosphere, and the LADEE mission.
- Has been implemented in the Ames Exploration Encounter which hosts half-day field trips for over 8,500 grade 4-6 students per year.
- Being adapted for use in the Challenger Learning Centers which reach 400,000 K-12 students per year.

Citizen Science and Student Participatory Exploration
LADEE and Lunar Meteoroid Impacts

- Partnering with NASA Meteoroid Environment Office (MSFC) and ALPO.
- Help determine rates of lunar meteoroid impacts.
- Meteoroid impacts are an important source for the lunar exosphere and dust.
- Will allow correlations between impact events and changes in exosphere structure and composition.
- Can be done with a telescope as small as 8 inches of aperture.
- Goal of increasing participation by at least 10% in the combined NASA and ALPO lunar impact monitoring programs.



Citizen Science and Student Participatory Exploration
LADEE and Meteor Counting

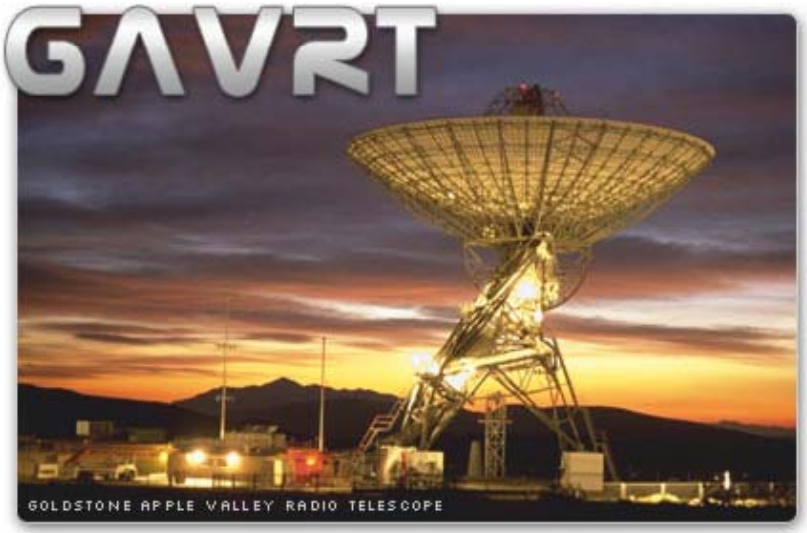
- The vast majority of meteoroids impacting the Moon are too small to be observable from Earth.
- Small meteoroids encountering the Earth's atmosphere can result in readily-observable meteors.
- Conducting counts of meteors during the LADEE mission will allow us to make inferences as to what is happening on the Moon at that time.
- Much more simple requirements: a dark sky, your eyes, and log sheet. (a reclining lawn chair is very nice too!)
- International Meteor Organization (http://imo.net/)
- American Meteor Society (http://www.amsmeteors.org/)
- Girl Scouts, Lewis Center for Educational Research, Challenger Centers.

LADEE Spacecraft Modeling at Navajo Technical College

- Students in the CAD and Modeling program are producing high-fidelity models of the LADEE spacecraft for mission E/PO and management.
- Program includes mission briefing and lunar science introduction for participating students.
- Meets NTC's need for a program that engages students in excitement of a NASA mission while remaining resident in the Navajo Nation.
- Course grew from groundwork implemented by NAI E/PO programs on the Navajo Nation.
- These programs help present lunar exploration in a culturally relevant and respectful way.

LADEE E/PO Future Plans

- GAVRT – Goldstone Apple Valley Radio Telescope run by Lewis Center for Educational Research.
- 34m DSS-12,DSS-13, and DSS-28 dishes at Goldstone.
- Used by thousands of K-12 students around the world.
- Over 1,700 students monitored spacecraft health and status during LCROSS mission.
- Conducted Doppler studies en route.
- Monitored medium gain transmissions during terminal approach.
- LADEE E/PO will facilitate NLSI and LCER plan to implement a GAVRT program for LADEE.



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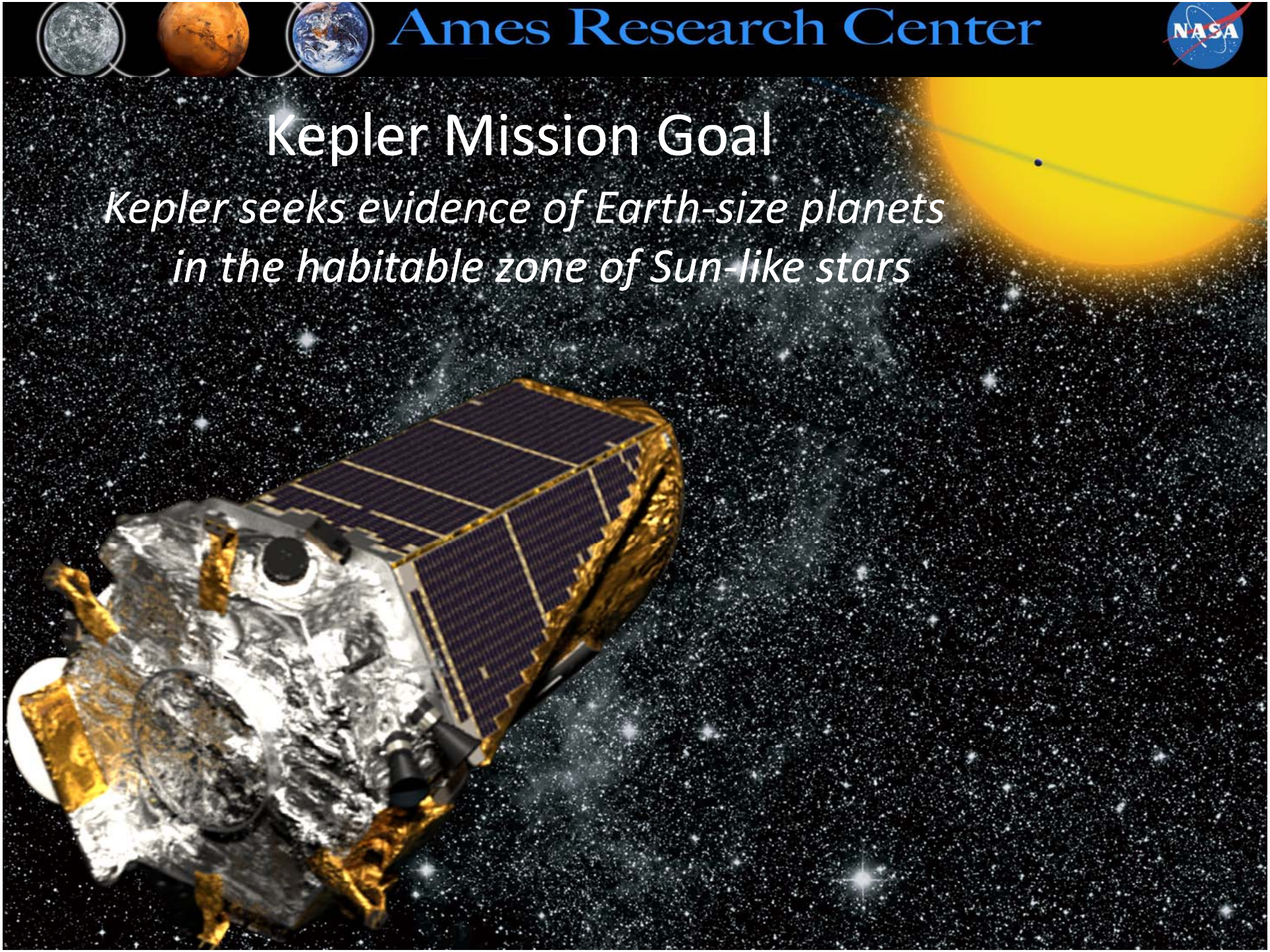
Kepler Mission E/PO: Sharing Exoplanets with Students, Teachers & the Public

Edna DeVore, SETI Institute

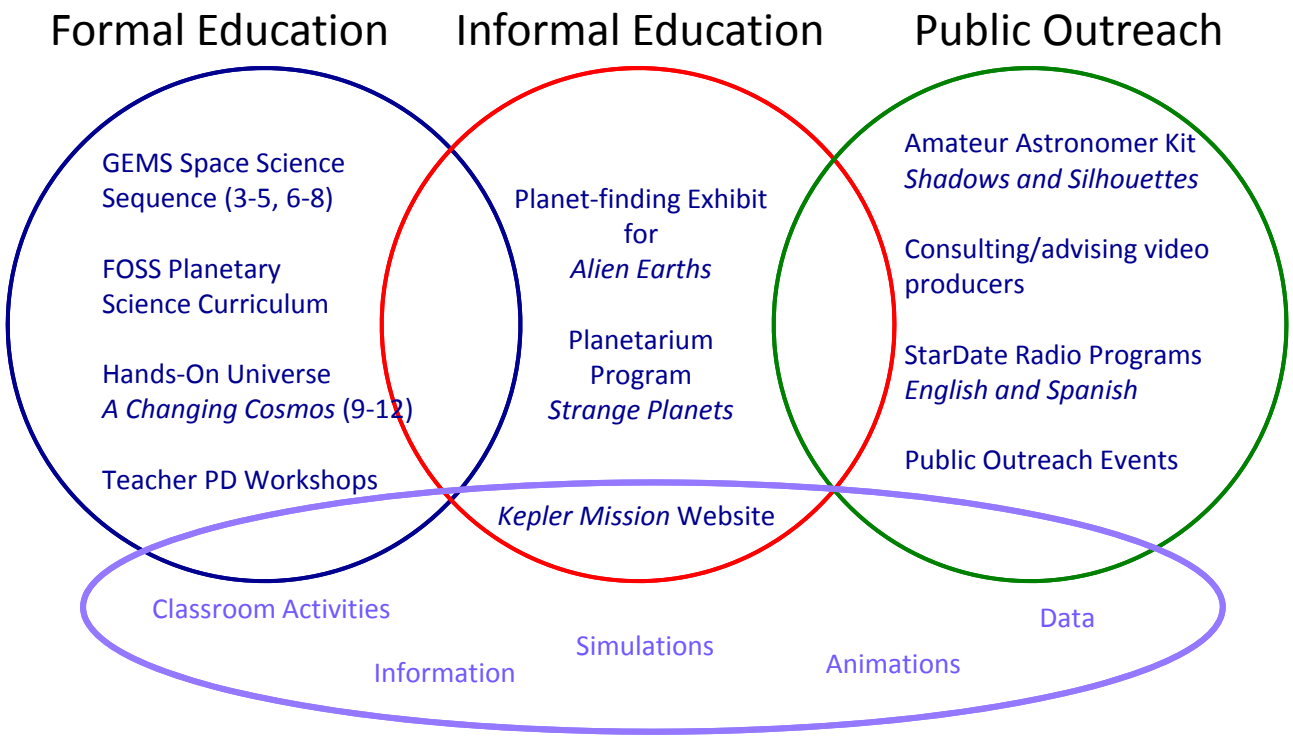
Alan Gould, Lawrence Hall of Science

SETI Institute

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY


Ames Research Center
NASA
Kepler Mission Goal
Kepler seeks evidence of Earth-size planets
in the habitable zone of Sun-like stars

Kepler EPO Summary:
EPO Domains — 2003 to 2013



SETI Institute

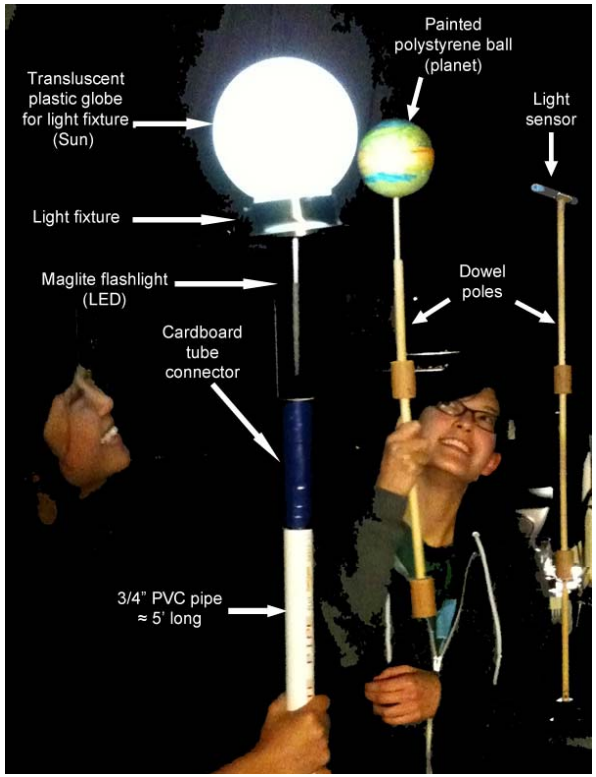
The Lawrence Hall of Science
University of California, Berkeley

Formal Education

- **TPD:** *Teacher Professional Development:* (grades 4-14) Short courses and workshops presented for 100's of pre- and in-service educators at colleges, universities, and STEM-related conferences.
- **GEMS:** *Space Science Sequences* (grades 3-5 & 6-8) Great Explorations in Math & Science is a national network of more than 60 centers and thousands of master teachers who use and train teachers with Space Science Sequences which include *Kepler*.
- **FOSS**: *Planetary Science Course* (grades 6-8). FOSS materials are implemented in thousands of classrooms in the United States. The revised Planetary Science course, which includes a *Kepler* Investigation, will be released in the fall 2011.
- **HOU:** *Hands On Universe* (grades 9-12) The HOU high school course, A Changing Cosmos, is now part of the Global Systems Science course and is distributed through Kendall-Hunt.

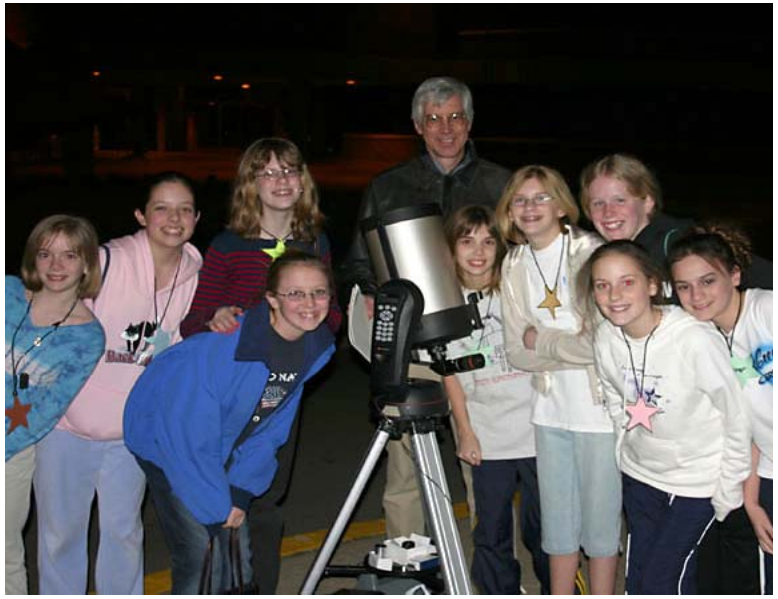
Informal Education

- **EXHIBITS:** *Alien Earths*, a public science center exhibit which included planet-transit component was produced by Space Science Institute & distributed through the Association of Science-Technology Centers for 5 years. Now a part of the permanent exhibit at the Virginia Air and Space Museum.
- **PLANETARIUM PROGRAM:** *Strange Planets*, an audience participation planetarium show that features Kepler, was distributed to ~ 100 planetariums; and is available for free download as a par of LHS's Planetarium Activities for Student Success project.



Public Outreach

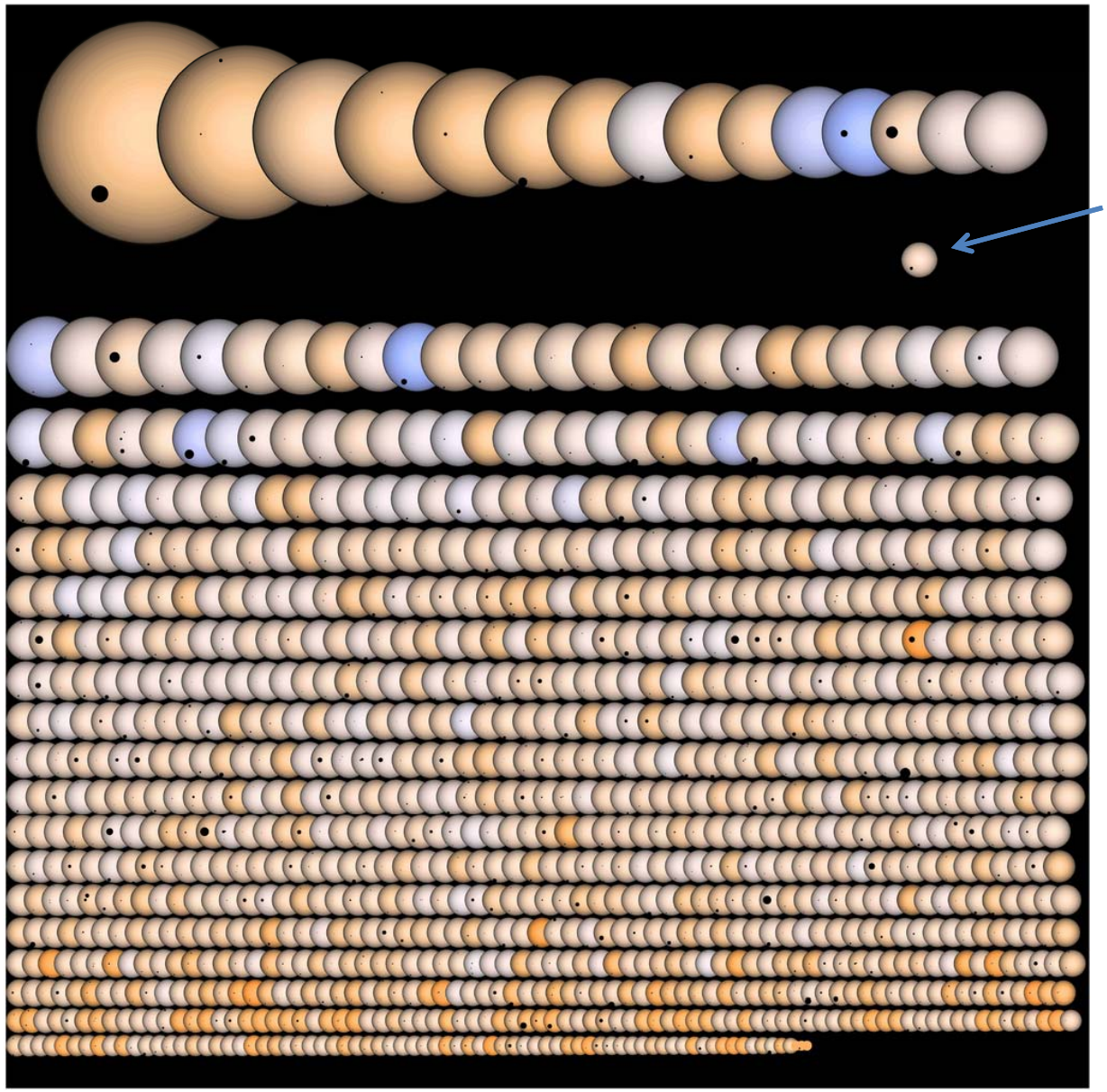
- **AMATEUR ASTRONOMERS:** *Shadows and Silhouettes* kits were distributed to more than 200 amateur astronomy clubs through the *Night Sky Network*, reaching more than 100,000 people in the past 5 years.
- **OUTREACH PRODUCTS:** Video, animations, print and downloadable materials used for broadcast productions, public outreach events, and public information.
- **RADIO PROGRAMS:** *StarDate* radio programs are produced by MacDonald Observatory, and heard weekly on more than 300 PBS and commercial radio stations reaching audience of 5 million in English and 3.7 million in Spanish.



- **KEPLER MISSION WEBSITE:** kepler.nasa.gov: The Mission website has a wealth of information for scientists, teachers, students and the public; interlinked with Kepler-related science websites, and with www.nasa.gov/missions/kepler.

Upcoming Activities:

- Website development –
  an ongoing process
- Venus transit collaboration with
  Heliophysics EPO
- *StarDate* programs
- Update for *Shadows and Silhouettes*
- Public contributions of planet artwork,
  The Art of Discovery (in planning)
- Teacher workshops and public presentations
- Publications in teaching journals with discovery poster
- Revisions of products as new discoveries are announced
- *Kepler* Challenger Center Mission
  (proposed to NASA SMD EPOSS)



The family portrait of the candidate planets

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SOFIA's E/PO Programs: Partnerships on Earth & in the Sky

SOFIA Outreach Lead:

Dr. Dana Backman (SETI Institute)

dbackman@sofia.usra.edu

ARC Building N211 Room 221

650-604-2128 voice, -1984 FAX

SOFIA E/PO

- Overarching goals:
  - Help enhance STEM education in select communities across the U.S. and Germany
  - Support NASA and the DLR's goals of inspiring the next generation of explorers.
  - Contribute to general public understanding of the value of scientific research.
  - Foster national and international visibility of the SOFIA program's achievements and discoveries.

SOFIA E/PO

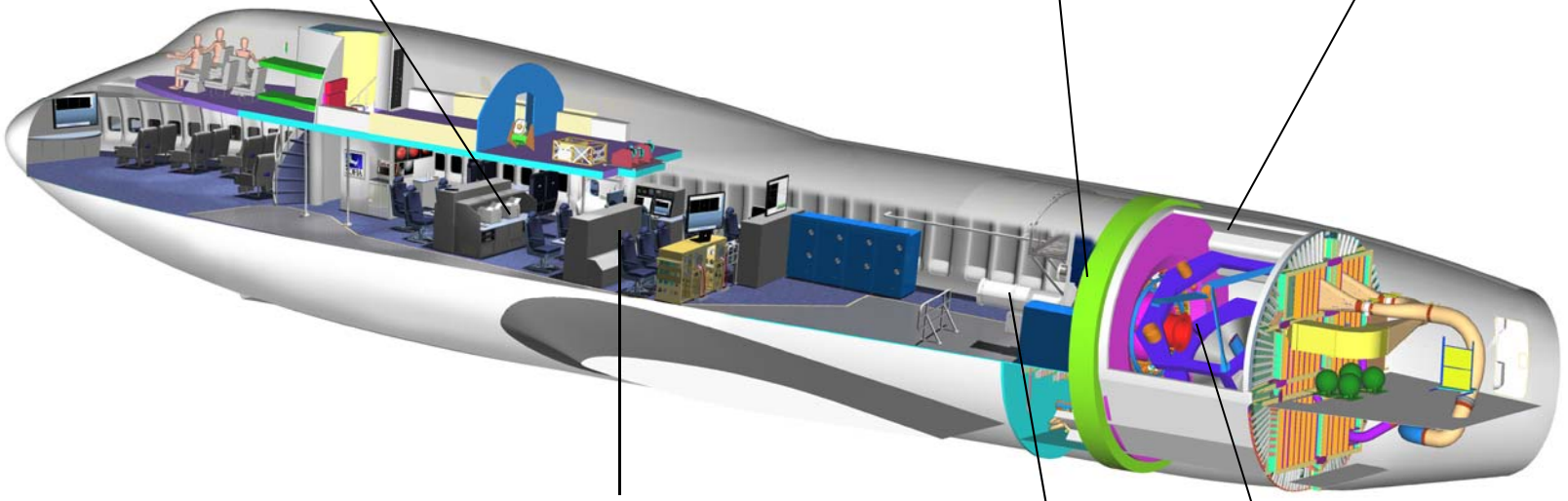
PROGRAMS & ACTIVITIES:

- Airborne Astronomy Ambassadors: flagship program, research flight experience for educators
- Production of classroom activities & curricula; school visits; educator workshops
- Exhibits in science museums and similar venues (e.g. Ames Visitors Center)
- Summer workshops for college faculty and undergraduates to encourage research
- SOFIA Science Center Web site content & mission “new media” presence
- SOFIA mission and E/PO printed materials
- Displays at public events (e.g. air shows, street fairs)

Educators Participating in SOFIA Science Flights to become Airborne Astronomy Ambassadors

- On May 10, NASA announced the selection of six educators from across the U.S. to serve as the first class of SOFIA Airborne Astronomy Ambassadors (AAAs).
- AAAs have developed specific plans for using their SOFIA experiences to inform their teaching, in addition to sharing their knowledge with other educators.
- The entire inaugural class of 6 U.S. and 2 German AAAs has now flown on SOFIA.

SOFIA — The Observatory



U.S. Airborne Astronomy Ambassadors 2011

- **U.S. AAA flights – May 26, June 1, June 3**

M. Beard
San Jose, CA

M. Blessing
Herdon, VA

C. DeWolf
Remus, MI

K. J. Fredette
Palmdale,CA

T. Paulsen
Mellen, WI

M. Piper
Frankfort, IL

1x DSI – partner schools (29) & 1x DLR School-Labs (9)

German educator flight
July 15

Dr. Wolfgang Vieser
Christoph-Probst-Gymnasium,
Gilching @ Munich

Jörg Trebs
Thomas Mann Oberschule -
Berlin Reinickendorf

Dr. Dörte Mehlert

Stratospheric Observatory for Infrared Astronomy

SOFIA E/PO

AAA program as envisioned during SOFIA's full operations, 2014+

- Teams of 2-4 educators chosen via national calls for proposals
- Proposal judgment criteria:
  - Quality of plans to enhance local STEM education and public outreach
  - Geographic and demographic diversity
- Partnered with consenting research teams; trained to understand flight research project; involved in flight series w/ research partners
- Supported by SOFIA Outreach after flights to fulfill proposed education projects
- Participants become a growing on-line support community
- 60+ educators per year (classroom teachers, science museum staff, etc.)

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NASA Astrobiology Institute (NAI)
Education and Public Outreach (E/PO) Program

Daniella Scalice

NAI E/PO Coordinator

daniella.m.scalice@nasa.gov

650.604.4024

What is Astrobiology?

- COLLABORATION IS KEY

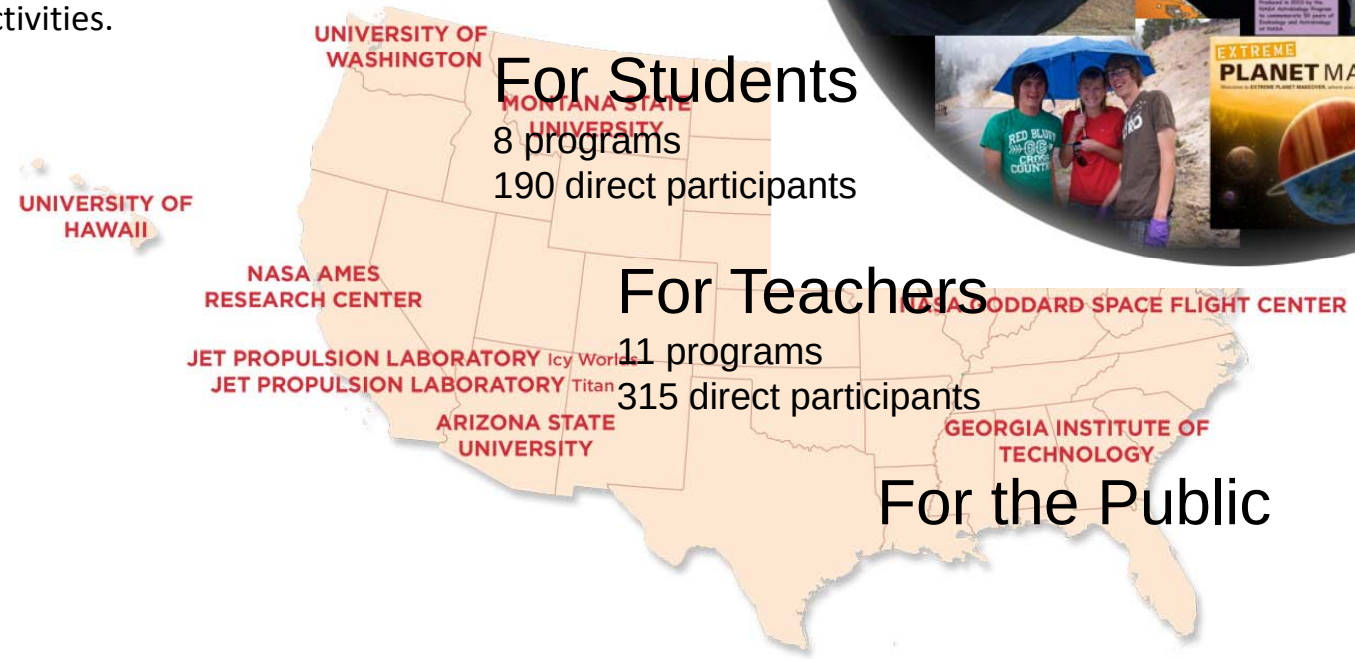
- Some major research themes in astrobiology are:
  - Cosmic Precursors, Solar System Formation
  - Origin of Life
  - Life in Extreme Environments
  - Biosignatures
  - Solar System Exploration (Mars, Europa, Titan, etc.)
  - Extrasolar Planets

Why is Astrobiology so appealing to students?

- Astrobiology tugs on those age-old questions that are buried deep in our DNA, and builds on our natural curiosity.
- The collaborative essence of astrobiology lends itself perfectly to working and learning in teams.
- The inherent challenges of exploration are ideal scenarios for problem-based learning.
- Astrobiology scoffs at the notion that ‘everything is already known’ and offers students a tangible sense that they can discover something and make an authentic contribution.

NASA Astrobiology Institute

- Initiated in 1998
- 14 interdisciplinary research teams all over the country, ~600 investigators
- Each team has an E/PO Lead and an E/PO plan.
- NAI Central's role is to facilitate communication and collaboration across the teams, make connections with new partners, ensure operation within NASA's guidelines, etc.
- The overall portfolio of projects draws strength from both community-based, regional partnerships and national-scale activities.



For Students

8 programs
190 direct participants

For Teachers

11 programs
315 direct participants

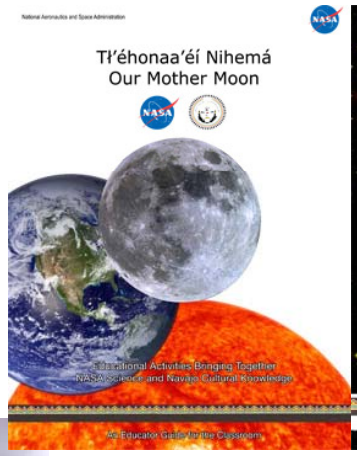
For the Public

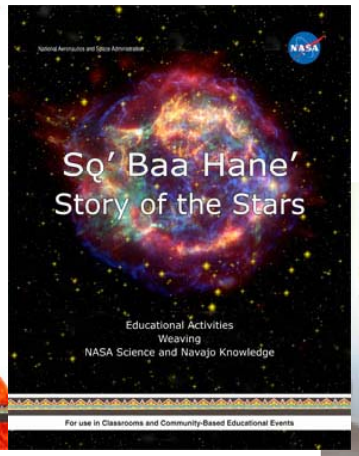
Beyond Summer Camp: Lassen Volcanic National Park Astrobiology Internship Program

- A partnership between the NAI team at NASA Ames Research Center, Red Bluff High School, and Lassen National Park in Northern California.
- ~10 high school student interns and scientists from Ames visit the Park multiple times throughout the school year collecting data and taking samples. Their field work is supplemented by lab work and monthly interactions with the scientists (via Polycom).
- **80% of interns will take additional science courses in high school, college, and/or continue their studies in astrobiology.**
- Program just completed its 3rd year; the partnership is growing to include 6 interpretive signs along trails in the Park explaining the astrobiological significance of some of the hydrothermal features.

NASA and the Navajo Nation

- Began in 2005 with a question: are you interested in partnering with NASA on educational programs?
- 6+ years later, we have co-developed two educator guides and just hosted our first summer camp
- "Dual-learning" environment enables scientific and cultural knowledge to co-exist without one dominating the other



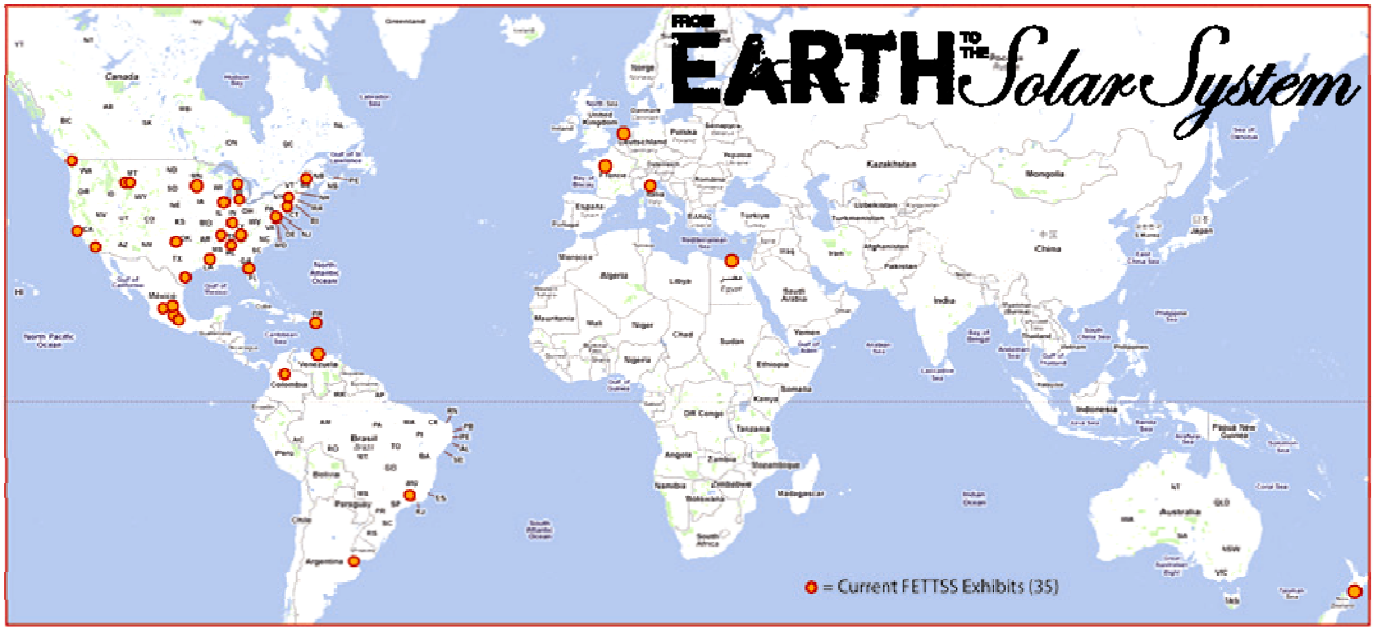


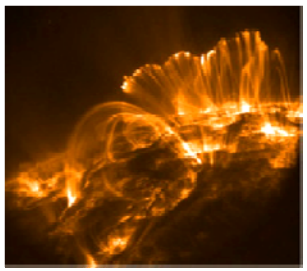
Strengthening Communities through Collaboration: MIRS

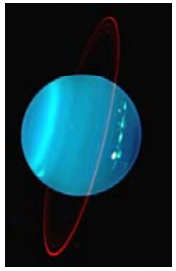
- The Minority Institution Research Support (MIRS) program provides sabbatical opportunities for MI faculty with Astrobiology researchers.
- A total of 16 fellows have been supported since the program's inception in 2003.
- Support is provided to the fellows for follow up research and collaborative activities, as well as student support and conference travel.
- Two MIRS fellows have gone on to support NASA missions: MSL (Prabhakar, Howard U) and observation time with Kepler (Walter, S. Carolina U).

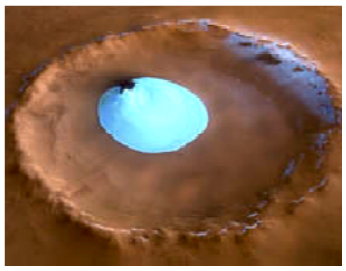
FETTSS: Free Choice Public Outreach

- *From Earth to the Solar System* (FETTSS) is a grassroots project that encourages "free-choice" learning.
- It is a collection of images showcasing traditional and unusual views of the Solar System as well as astrobiology field sites on Earth.
- The collection is freely available online and organizations can mount exhibitions wherever and however they choose!



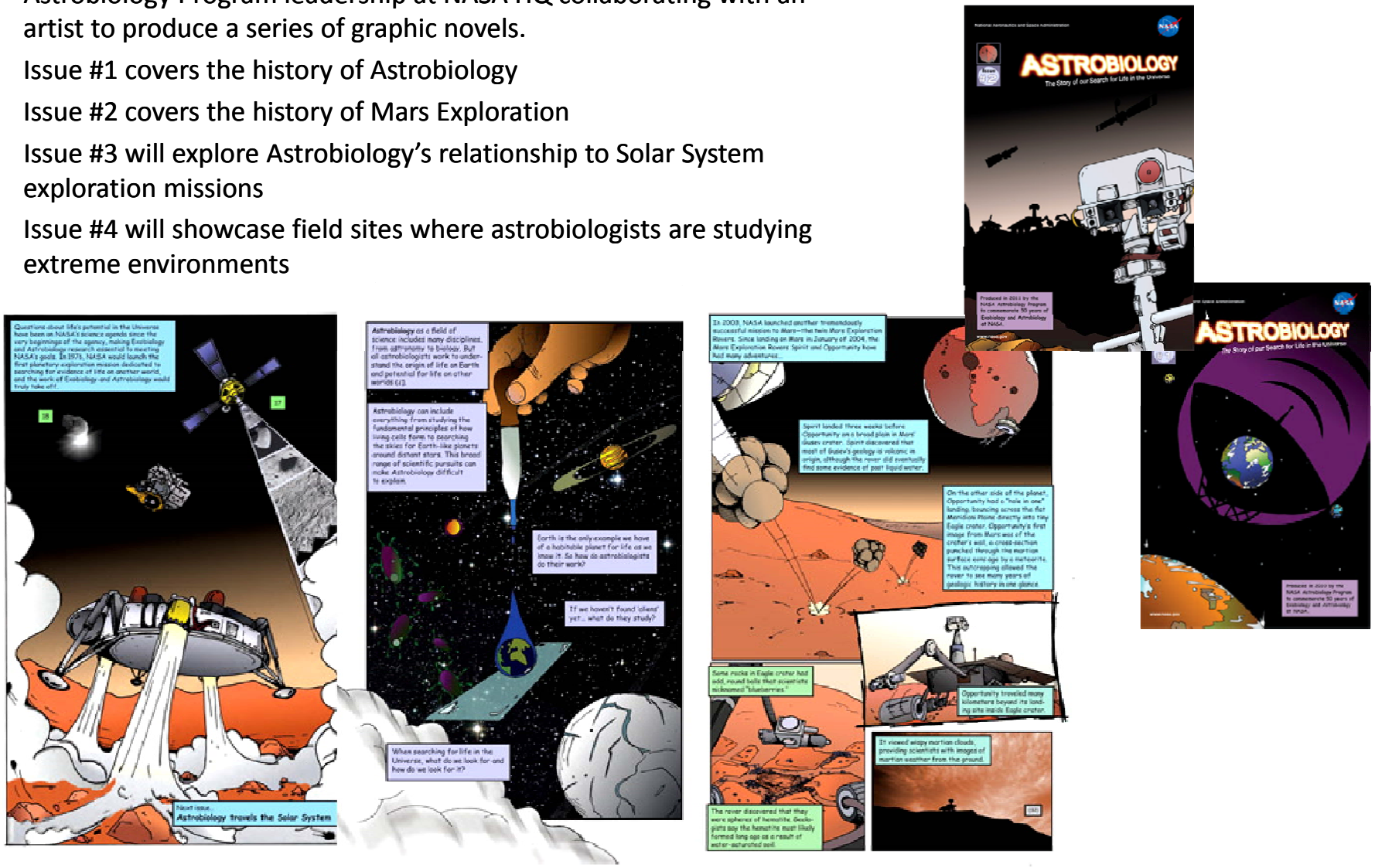






Innovative Products: Astrobiology Graphic Novels

- Astrobiology Program leadership at NASA HQ collaborating with an artist to produce a series of graphic novels.
- Issue #1 covers the history of Astrobiology
- Issue #2 covers the history of Mars Exploration
- Issue #3 will explore Astrobiology's relationship to Solar System exploration missions
- Issue #4 will showcase field sites where astrobiologists are studying extreme environments



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NASA Lunar Science Institute EPO Overview

Dr. Yvonne Pendleton

Director

yvonne.pendleton@nasa.gov

http://lunarscience.nasa.gov

U.S. Member Teams

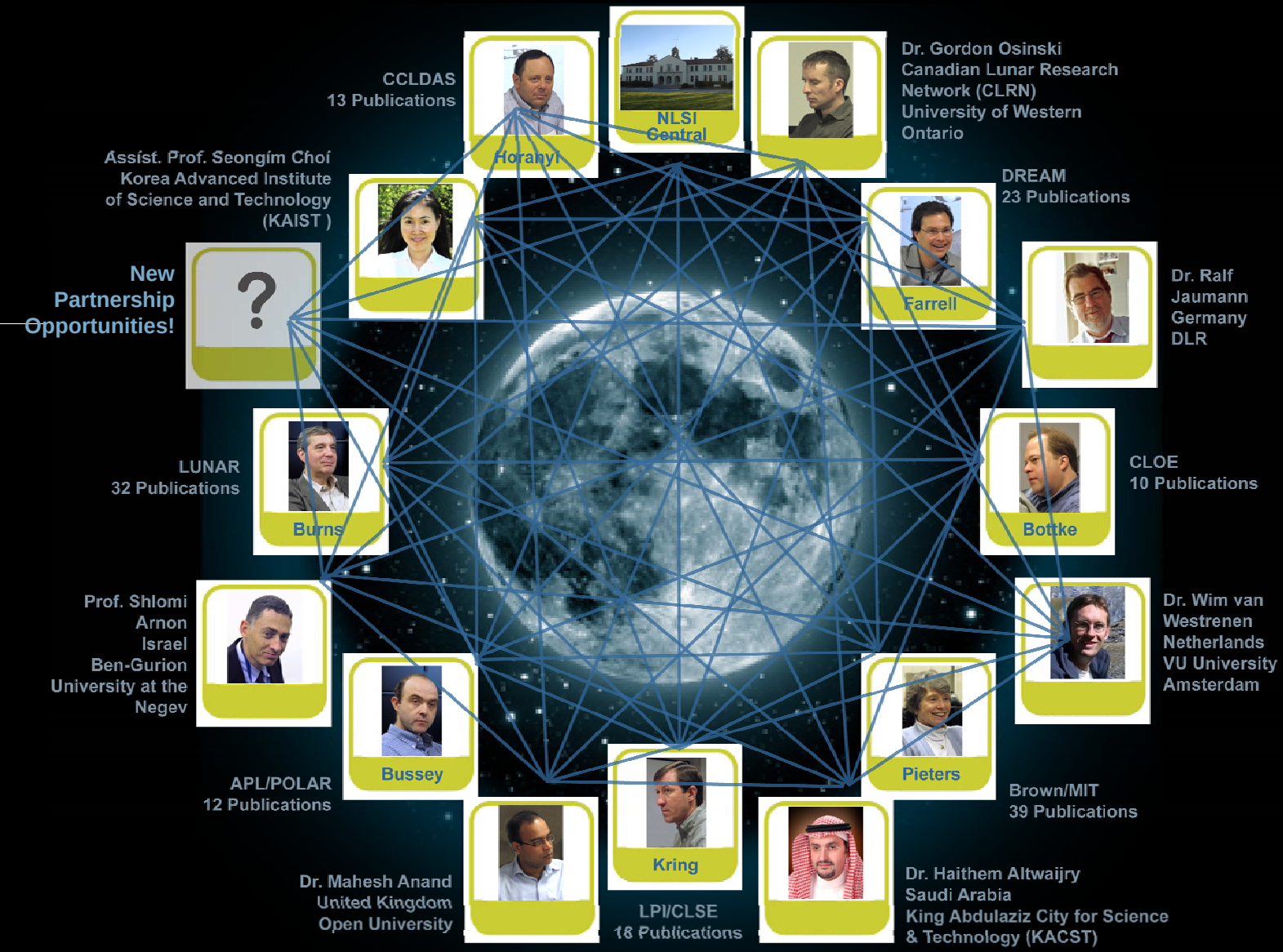
The collaborative nature of the virtual institute fosters cross-team and inter-disciplinary research.

New communication technologies support synergistic research between geographically disparate teams.

International Partnerships

A growing network of International partners participate in NLSI activities on a no-exchange-of-funds basis.

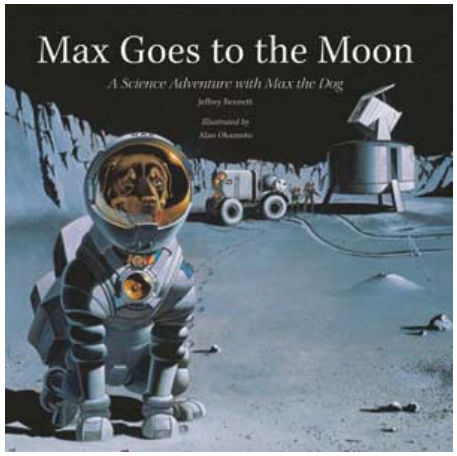
Together, we've got the Moon covered!



NASA Lunar Science Institute (NLSI)
Education and Public Outreach (EPO) Highlights

- Citizen Science/Moon Zoo
- International Observe the Moon Night
- Planetarium Show: Max Goes to the Moon
- Braille Book on Lunar Craters
- The little rover that could:
  - Exploration Uplink

NLSI: Reaching Out to Everyone



- Citizen Science invites volunteers to participate in scientific observations, measurements and computations
- The NLSI Moon Zoo program enables citizen scientists to identify lunar features in NASA's Lunar Reconnaissance Orbiter (LRO) images
- International Observe the Moon Night (InOMN), is an annual world-wide public event that uses the Moon to reach, teach and inspire
- *Max Goes to the Moon* is a planetarium show for grade K-5 students and the public developed by the NLSI team led by Jack Burns (University of Colorado)

NLSI: Reaching Out to Everyone!

Impact:

- Moon Zoo: 45,000 participants first year; 4.2 Million Areas of Interest identified = 600,000 possible craters
- InOMN 2010 had 502 events in 53 countries, reaching an estimated 500,000 people, including troops in Afghanistan
- *Max Goes to the Moon* debuted at the Lunar Science Forum; input and endorsement from ~600 lunar scientists obtained

Max Goes to the Moon (clip)

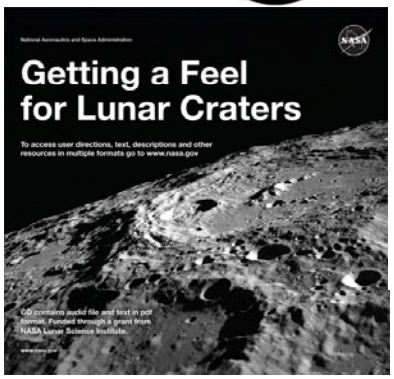
NLSI: Reaching Out to Everyone!

Future Plans:

- Max Goes to the Moon, and to planetariums nation-wide this fall
- NLSI Blumberg Citizen Science Post-Doctoral Fellowship just created to further connect the public to NASA's mission
- Moon Zoo + Lunar Orbiter Image Recovery Project (LOIRP): connecting two generations as 21st century students search for post-1960's lunar impacts!
- Save the date: October 8, 2011

Baruch Blumberg, NLSI Distinguished Scientist

Lori Garver visits LOIRP Project at NASA ARC's "McMoon"



Braille Book: Getting a Feel for Lunar Craters

NLSI worked with author David Hurd to bring his "vision" to those who cannot see *Getting a Feel for Lunar Craters* features tactile diagrams, revealing the wonders of *Our* Moon

Impact:

- 250 books immediately claimed; second set instantly backordered (requests peaked at 100/hour); currently printing 1000 additional copies and discussing options with partners to meet future needs
- At the reception event, Bay area blind students were given their own copy of the book, before being told what it was. Immediately swiping their hands across each page, they exclaimed excitedly, "This is OUR Moon!" with priceless expressions on their faces as they felt the lunar surface, and "saw" our Moon, for the very first time.

Future Plans:

- NLSI is committed to the development of resources that bring NASA science and exploration to the world of those who cannot see
- Immediate goal: work with partners to distribute books to all state libraries and schools for the blind, and assess educational impact in the classroom. Additional tactile & teacher workshops will be developed
- Present book to White House staff at GSFC, August 3, 2011, as requested

Dr. Marc Maurer, President of the NFB, seeing the Moon for the first time

Ames Research Center

Exploration Uplink

Participatory Exploration Using Tele-robotic Systems

- Exploration Uplink uses tele-robotics to bring NASA science & exploration into classrooms around the world
- Students operate rover from anywhere in the world with a browser; science comes along for the ride!
- Lunar dust simulant testbed repurposed (from 2009 Lunar Regolith Excavation Centennial Challenge)

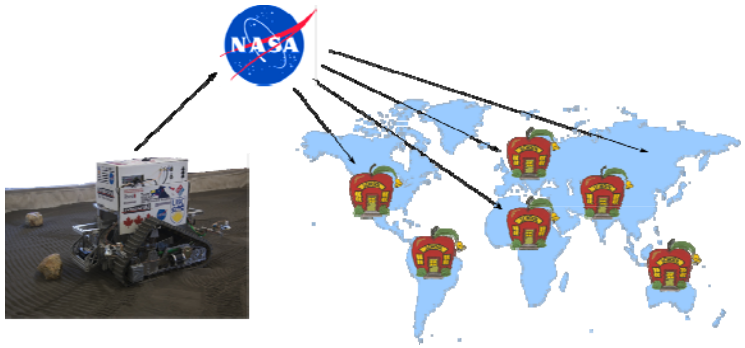
Impact:

- ~4,000 U.S. and International students met rover in 2010
- 5 International events with public audiences of several hundred (South Africa, South Korea, Canada, UAE)
- Interactive demonstrations: Traveling Space Museums, California School for the Blind, & NASA Explorer Schools

Future Plans:

- NLSI Teams will develop additional science content
- Working with Girl and Boy Scouts to develop patch programs
- Expanded field test opportunities in 2011 with 2 new rovers

Exploration Uplink and the NLSI: Reaching Out to Everyone!



NASA Science & Exploration

Ames Research Center

Exploration Uplink

Participatory Exploration Using Tele-robotic Systems


NASA
LUNAR
SCIENCE
INSTITUTE
lunarscience.nasa.gov
Bringing
Lunar Science
to a New Generation

NASA Lunar Science Institute

BACK UP SLIDES

Teacher Course & Workshops

Description:

- Teacher training offers great leveraging to educate large numbers of students
  - "Geology of the Moon" is a 3 credit NLSI-sponsored online course at Montana State for K-12 teachers
  - NLSI Teams sponsor many workshops each year for Middle & High School Teachers, such as
  - Cosmos in the Classroom,
  - Journey Through the Universe,
  - Educators “Of the Moon, On the Moon, From the Moon”

Teacher Course & Workshops

Impact:

- NLSI-sponsored *Geology of the Moon* course served 65 teachers in the first two years; course evaluations indicate 100% recommend this course to colleagues

- NLSI-sponsored *Educators "Of the Moon, On the Moon, From the Moon"* workshops reached 105 teachers, grades 6-12, in 2010

- NLSI-sponsored workshops for college faculty reached 40 instructors in 2010

Teacher Course & Workshops

Future Plans:

- Continue providing *Geology of the Moon* course; develop additional content; advertise broadly using social media to extend outreach
- Expand online course offerings to highlight science and exploration
- Partner with other Universities to offer course credit for participants
- Enhance collaboration between NLSI Teams to better focus teacher workshops on underserved student populations

Back-up Charts

Additional Program Information

Ames Research Center

ZERO ROBOTICS and SPHERES on ISS

Bruce Yost

SPHERES Program Manager

650 604-0681

bruce.d.yost@nasa.gov

What is SPHERES?

SPHERES is an internal test bed for the development and testing of estimation, control, and autonomy algorithms for distributed satellite systems

- Test how to program satellites so that they do missions that need formation flight, docking, in-space assembly, etc, with minimal human intervention
- Useful for future missions such as separated spacecraft telescopes, autonomous servicing missions, and in-space assembly of inter-planetary spacecraft
- Central to Zero Robotics annual competitions

Synchronized Position Hold Engage and Reorient Experimental Satellites (SPHERES)

- Developed by MIT for DARPA
- Flying on ISS since 2006
- Ongoing research program for NASA
- Sponsored by SOMD Chief Technologist

What is ZERO ROBOTICS *?*

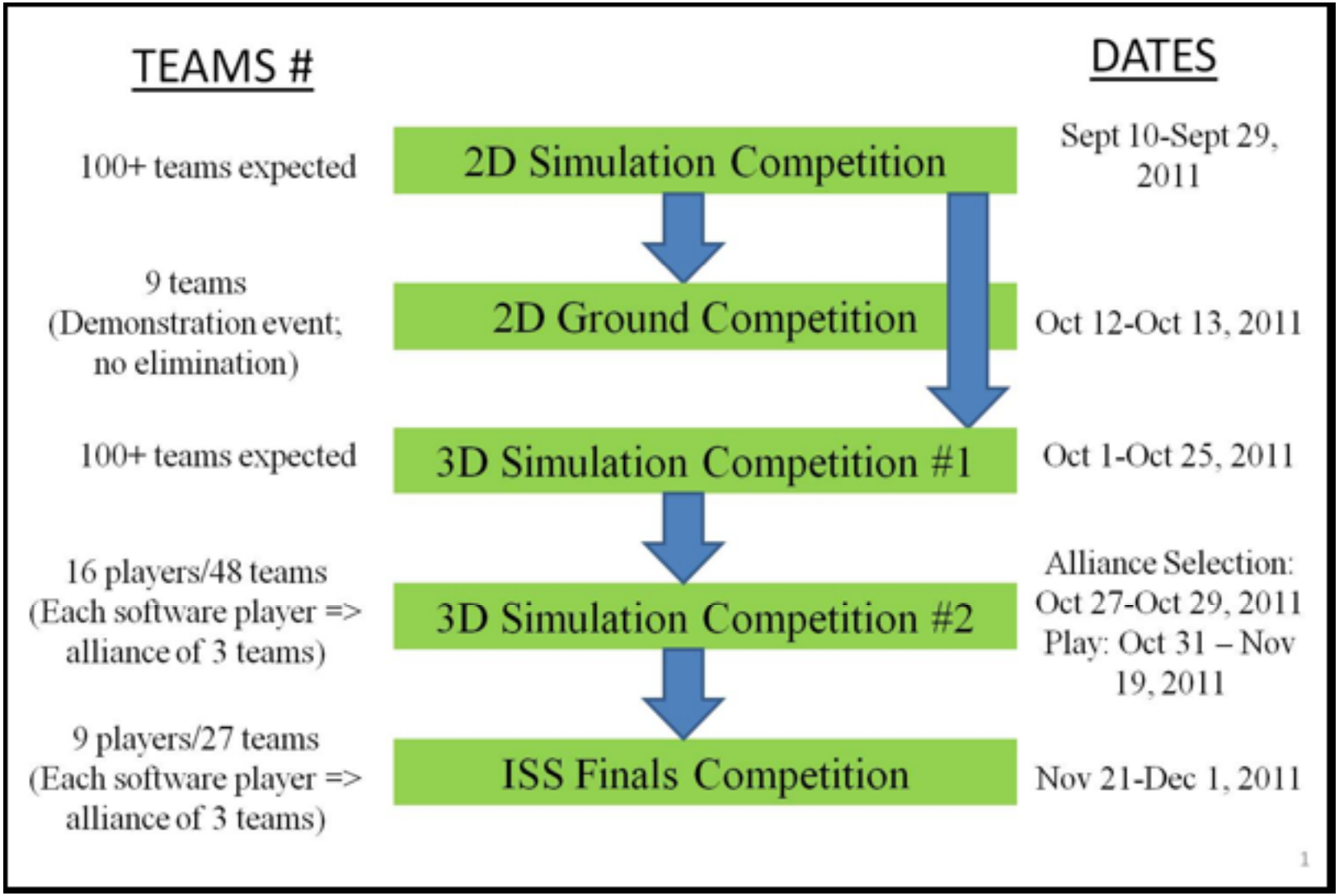
Zero Robotics is an arena robotics competition with the "arena" on ISS.

- Robotics competition open to middle (August) and high school (December) teams.
  - Students will actually write programs that may control a satellite in space.
- MIT and NASA HQ developed program with DARPA participation and support.
  - Inspired by *FIRST* Robotics Program; part of NASA's 2010 SoI program.
- Pilot session in 2009; Boston area competition in 2010 and 2011 (DARPA funded).
- NASA/ARC working with MIT and NASA/KSC to expand participation in 2012 and beyond.

2010 Session Summary (Middle schools)

- 200 participants
- 84% from low-income families
- 54% female
- Daily attendance rate >90%

2011 ZR Schedule (High Schools)



More information:

Zero Robotics/MIT

http://zerorobotics.mit.edu/

DARPA/TTO

http://www.darpa.mil/Our_Work/TTO/Programs/InSpire/International_Space_Station_%28ISS%29_SPHERES_Integrated_Research_Experiments.aspx

SPHERES Videos

http://www.youtube.com/watch?v=I-ecRSSHhII&feature=related

http://www.youtube.com/watch?v=nl6lZbyLkzs&feature=related